DOCUMENT RESUME

ED 144 516 HE 009 307

TITLE Estimating Manpower Requirements. A Background Paper Prepared for the Graduate Medical Education Advisory Committee. Report No. 76-114.

INSTITUTION Health Resources Administration (DHEW/PHS), Bethesda, Md. Bureau of Health Manpower.

PUB DATE Mar 77

NOTE 50p.

AVAILABLE FROM Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Stock No. 241-186/1076)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.

DESCRIPTORS *Health Education; *Health Occupations; Health Occupations Education; Health Personnel; Health Services; *Higher Education; *Manpower Needs; Manpower Utilization; Medicine; Personnel Needs; *Physicians; *Prediction; Primary Health Care

ABSTRACT

This report on estimating physician manpower requirements is intended as a history and summary of the state of the art in manpower requirements estimation and forecasting. It describes the various ways in which manpower requirements have been estimated in recent years and discusses the variety of concepts, methods, definitions, and approaches that have been or can be used. It indicates some of the problems and limitations of current methods of estimating requirements and presents some existing requirements estimates for medical specialties. It also describes some of the needed improvements in data and methodology and offers some options for development of more adequate requirements estimates. Because the Graduate Medical Education Advisory Committee deals with ways of adjusting residency positions to meet the requirements for medical specialties in the coming years, the paper emphasizes projections of these requirements more than it does estimation of current requirements. (Author/JMF)

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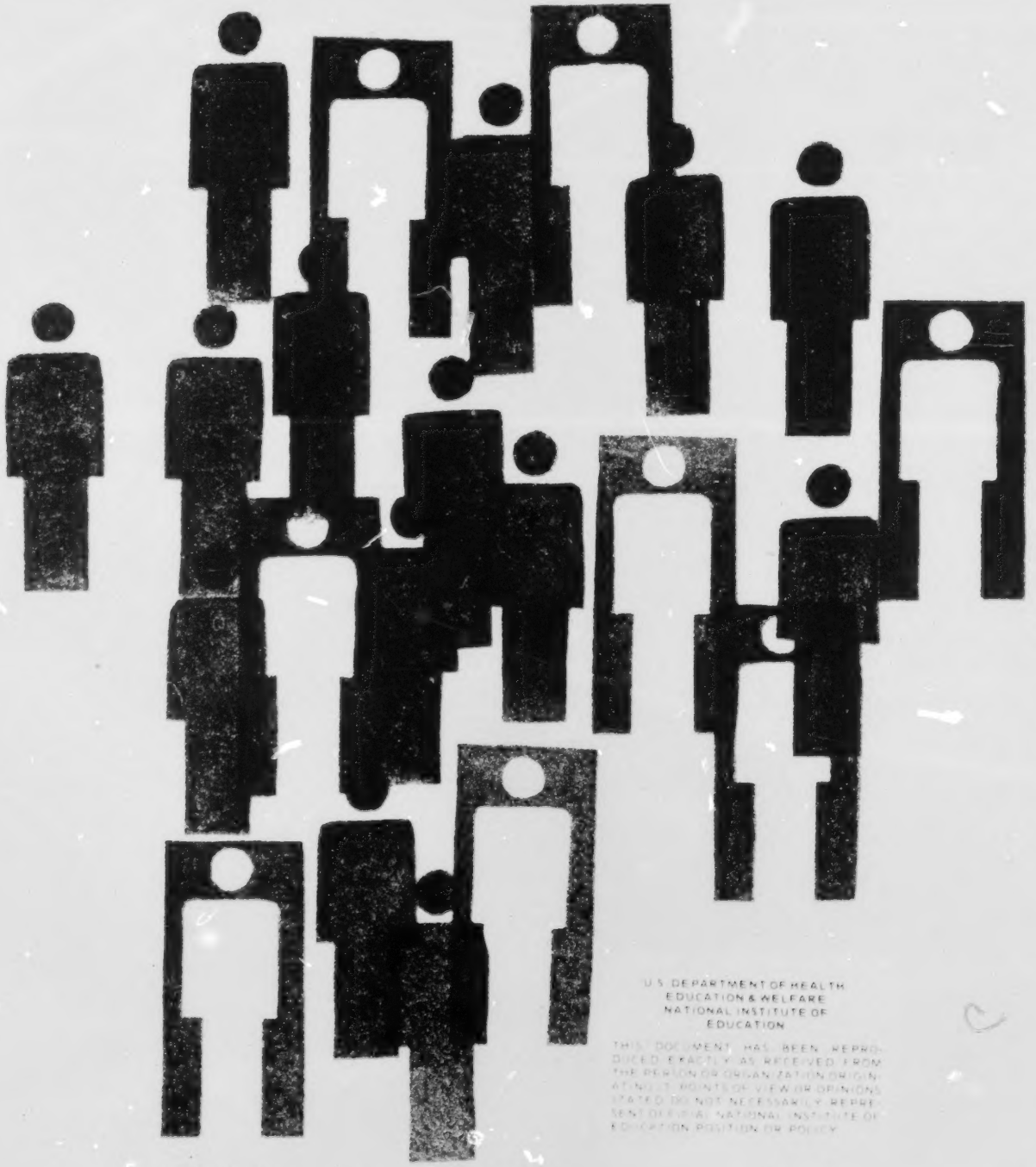
Estimating Manpower Requirements

A Background Paper



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U.S. DEPARTMENT OF
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Public Health Service
Health Resources Administration

Estimating Manpower Requirements

A Background Paper Prepared for the Graduate Medical Education Advisory Committee

BHM/OPD/MAB
3/8/77
Report No. 76-114

3/4/5

Table of Contents

		Page
Preface		1
I.	History of Health Manpower Requirements	2
II.	Dimensions of Requirements Estimation	7
	Potential Objectives of Estimation Process	7
	Time Frame of Health Manpower Requirements Estimates	9
	Delivery System Characteristics	11
	Conceptual and Definitional Constraints	12
III.	Theoretical and Practical Concepts for Quantification	15
IV.	Factors Affecting Requirements	19
	Demand Factors	19
	Health Care System Changes	21
V.	Methodological Approaches to Requirements Estimation and Forecasting--Advantages and Disadvantages	23
	Manpower/Population Ratios and Utilization Models	23
	Trend Analysis and Trend Models	24
	Professional Judgment Approaches	25
	Econometric Model Approaches	26
	Optimizing Models	27
	International Comparison Approaches	27
VI.	State-of-the-Art and Available Requirements Estimates	28
	State-of-the-Art of Manpower Requirements Estimation	28
	Current Estimates of Medical Specialist Requirements	31
	Medical Specialty Studies	34
VII.	Development of a Research Strategy	36
	The Roles of Short and Long-Term Analysis	37
	The Structuring of an Analytic Approach	38
	Development of an Illustrative Methodology	39
Conclusion		43

ESTIMATING MANPOWER REQUIREMENTS

Preface

This report on estimating manpower requirements was prepared by the Bureau of Health Manpower's Manpower Analysis Branch as one of several background papers prepared for the Graduate Medical Education Advisory Committee (GMENAC). The report is intended as a history and summary of the state-of-the-art in manpower requirements estimation and forecasting. It describes the various ways in which manpower requirements have been estimated in recent years and discusses the variety of concepts, methods, definitions, and approaches that have been or can be used. It indicates some of the problems and limitations of current methods of estimating requirements and presents some existing requirements estimates for medical specialties. It also describes some of the needed improvements in data and methodology and offers some options for development of more adequate requirements estimates.

Because the GMENAC is dealing with ways of adjusting residency positions to meet the requirements for medical specialties in the coming years, the paper emphasizes projections of these requirements more than it does estimation of current requirements. However, both aspects are dealt with in the report, reflecting the fact that future requirements must be based on an understanding of and and insight into current ones.

The report was prepared in the Bureau of Health Manpower's Manpower Analysis Branch, Howard V. Stambler, Chief. Staff members of MAB who contributed to the preparation of the report were Roger B. Cole, Marion Altenderfer, Stuart Bernstein, Ruth Crocker, James Morrow, James Cultice, and Nancy Walczak.

I. History of Health Manpower Requirements Estimation

Over the years, there have been many attempts made to estimate physician requirements, by Federal commissions and task forces, government agencies, professional associations, researchers, and other organizations and individuals. These efforts have differed widely in purpose, comprehensiveness, approach, acceptability, and usefulness. The methodology and sophistication involved have ranged from use of simple ratios of all physicians to total U.S. population to elaborate computer models that attempt to reproduce the entire health care system or the way in which physicians and patients act and interact. They have been based on expert opinions or professional judgment as to ideal or optimum utilization ratios, on the economic demand for services, on medical need as measured by health status, and on combinations of these and other methods. Some have examined current requirements, while others have looked many years into the future. Most studies have dealt only with total numbers of physicians. Others have made estimates of requirements for physicians only in particular settings, such as in public health, hospitals, research, or the Armed Forces. Although most studies have been concerned solely with requirements for physicians, a few have included requirements for other health professions as well. Until very recently, however, few studies have attempted to estimate requirements for individual physician specialties, and even fewer have systematically addressed requirements for different specialties within the same study.

One of the earliest physician requirement studies is reported in the classic Lee-Jones monograph of 1933 (1), which estimated the number of physicians required to prevent, diagnose, and treat specific diseases and health conditions. This type of approach, based on professional opinion of the general practitioners and specialists needed for good medical care, and on estimates of the incidence and prevalence of conditions requiring care, has never been completely replicated. The 1972 study by Schonfeld et al. (2) adapted this method in estimating the number of internists and pediatricians needed to provide primary care. A weakness of this study is its failure to consider the primary care furnished by general and family practitioners and by other specialists.

A different approach was used in the 1949 study by Mountin et al. (3) of the U.S. Public Health Service. This study used as a model the 1940 physician/population ratios for general practitioners and 14 specialists in top areas among the 126 medical service areas of the United States to estimate 1960 requirements for physicians.

A 1967 report by the Bureau of Health Manpower (4) used the average ratios of 16 specialists to population served in six prepaid group practices to estimate the physician requirements for personal health

care. This requirement, together with the requirements for interns and residents, teaching, research, administration, and public health, yielded the widely quoted shortage of 50,000 total physicians.

In one of the most useful recent studies, Mason in 1972 (5) used data from selected prepaid group practices to estimate the average number of persons per physician for 20 specialties, but did not estimate the number of physicians needed for provision of services other than personal health care. The usefulness of these estimates is constrained, however, by the selectivity in the population with membership in prepaid group practices and by significant differences between the plans in covered services, etc. In 1973, Paxton (6) provided estimates of the number of 22 specialties needed in 1972 and 1980 on the basis of "ideal" population per M.D. ratios as estimated by specialty leaders.

In addition to the studies mentioned above, a number of reports have provided estimates of physician requirements from widely different points of view. The medical and social aspects of physician requirements are emphasized by the Magnuson report (7), the Bane report (8), the National Advisory Commission on Health Manpower (9), and the Carnegie Commission on Higher Education (10). The economic aspects of physician requirements are emphasized by Feldstein (11), Fein (12), Ginzberg (13), and the U.S. Department of Labor (14).

During the 1970's, the focus of physician requirements studies shifted to physician specialties, and a number of such studies were undertaken, usually by or for specialty associations, and frequently with Federal government support. Although many of these studies were more sophisticated than the earlier ones, they varied from studies in which definitions and methodology were rigorously established, to those that simply documented or summarized the opinions of a selected group of experts. Nevertheless, most expressed the same theme as earlier studies-- that an expansion in physician numbers was needed.

Probably the most detailed and comprehensive study of an individual specialty so far developed has been SOSSUS--the Study on Surgical Services for the United States (15). Data were obtained from two major studies, the first a questionnaire and a log-diary study of a one-in-eight random sample of all physicians in the United States who performed operations. In the second study, data were obtained on all in-hospital operations done by all physicians in four selected U.S. regions. Based on findings from these two studies, and others as well, the SOSSUS Manpower Sub-committee recommended effecting a reduction in the number of physicians doing operations by reducing the number of surgical residents.

The questionnaire and log-diary approach was also used to develop a profile of the cardiologist (16), whereas surveys to determine

practice characteristics of thoracic surgeons (17) and orthopedists (18) used questionnaires. The latter survey also used observers to record how physicians allocated their professional time and defined a serious shortage of orthopedists. The validity of the definition is open to serious question, however, since even physicians in the same specialty differ significantly in their responses to patient problems. By combining the number of funded institutional vacancies for physicians in pulmonary disease patient care, teaching, and research with the "ideal" numbers needed for 100,000 population, the Manpower Survey Committee of the American Thoracic Society and the American College of Chest Physicians estimated increases needed in the number of pulmonary disease physicians (19). A similar approach was used to estimate needs for pathologists (20).

Findings from a survey of 10 prepaid group health plans were adjusted to compensate for the prepaid group framework and used to develop an estimate of dermatologists per 100,000 population and of the number of additional dermatologists needed (21).

Using available data and evaluating the factors believed to affect the demand for services, the American Council on Radiology's Task Force on Manpower and Facilities developed specialty and sub-specialty estimates of manpower needs to 1980 (22). The Task Force also examined the geographic imbalance but identified no significant national shortage or surplus.

Data on office visits reported in a survey of practicing otolaryngologists and in surveys conducted by the National Center for Health Statistics (NCHS) were combined with detailed estimates of per capita utilization to develop manpower projections for otolaryngologists to 1985 (23). The approach taken also incorporated estimates of population growth, utilization patterns, and other factors. An unusually complete and detailed description of how the estimates of supply and requirements were developed is presented in the report.

In general, the data contained in the recent reports on individual specialties described above are accurate and comprehensive. Such deficiencies as may exist in the development of requirements estimates from the data arise primarily from the failure to recognize or to acknowledge the overlap between specialists (and non-specialists) in broad areas of patient care, and to provide an empirical basis for selection of the "ideal" requirements derived.

(1) Lee, Roger I. and Jones, Lewis W. The Fundamentals of Good Medical Care. Chicago, University of Chicago Press, 1933.

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(3) Mountin, Joseph W.; Pennell, Elliott H.; and Berger, Anne G. Health Service Areas. Estimates of Future Physician Requirements. Public Health Bulletin No. 305. Washington, U.S. Government Printing Office, 1967.

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(5) Mason, Henry R. Manpower Needs by Specialty. Journal of the American Medical Association 219: 1621-1626, March 20, 1972.

(6) Paxton, Harry T. Doctor Shortage? It's Narrowing Down to Primary Care. Medical Economics pp. 104-107, March 19, 1973.

(7) U.S. President's Commission on the Health Needs of the Nation. Building America's Health: A Report to the President. Washington, U.S. Government Printing Office, 1952.

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(9) Report of the National Advisory Commission of Health Manpower. Vols. I, II. Washington, U.S. Government Printing Office, 1967.

(10) The Carnegie Commission on Higher Education. Higher Education and the Nation's Health. Policies for Medical and Dental Education. Hightstown, New Jersey, McGraw-Hill Company, 1970.

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(19) Manpower Survey Committee of the American Thoracic Society and the American College of Chest Physicians: Survey of Professional Manpower in Pulmonary Diseases. A Report Prepared for the National Heart and Lung Institute. November 1972.

(20) Pathology Manpower Needs in the United States. In press. American Journal of Clinical Pathology. 1976.

(21) Krasner, M., Ramsey, D.L., Weary, P.E. National Dermatology Requirements: The Experience of Prepaid Group Practices. Final Report. 1975.

(22) Report of the American College of Radiology Task Force on Manpower and Facilities. February 1975.

(23) Manpower Resources and Needs in Otolaryngology. The American Council of Otolaryngology. The Annals of Otology, Rhinology and Laryngology. Supplement 24 - Vol. 85, January-February 1976, No. 1, Part 2.

II. Dimensions of Requirements Estimation

The processes of health manpower requirements estimation are generally defined by the potential objectives of the specific process, the time frame for the estimates being made, the characteristics of the delivery system to which the estimates are applicable, and the constraints imposed by the concepts and definitions being used. In this section, each of those elements of the estimation process is discussed in some detail.

Potential Objectives of Estimation Process

A major goal of requirements estimation is to determine whether health manpower resources, current or future, are or will be adequate to meet the requirements for delivery of health services. The concept of "Requirements" used here refers to the manpower necessary to provide the desired health services to the population, however defined. The size and composition of the requirements estimate for health manpower is sensitive or specific not only to the particular population, but also to the level, intensity, and quality of health services and to the organization of the health delivery system assumed. In view of the derived nature of manpower requirements, anything that affects the level, composition, and quality of the services to be provided must be taken into account, since it will also affect manpower requirements.

The beginning stage in the analysis of health manpower requirements of any kind is the determination of the basis for the service requirement, which is the ultimate objective being sought. No single method of measuring requirements for health services, and consequently requirements for health manpower, has proven entirely satisfactory or universally applicable, and many different measures can be used. Each analysis must weigh the alternatives and select the methodology or mix of methodologies appropriate to the purpose of the analysis and to the data, and must evaluate and analyze the issues and results from this perspective.

One way to measure health services requirements is in terms of medical need, as evidenced by professional judgments, health status, morbidity, and disability rates. Another is to estimate economic demand which reflects the willingness and ability of consumers to pay for health services, whether or not medically "needed." A third way might be to define requirements standards in terms of maintenance of some utilization level. Each can serve a useful purpose, depending on the objective being sought by the estimator.

The concept of "need" is usually understood to refer to some level of health service that "ought" to be consumed in order to attain and

maintain a desired health status (biological), determined according to some professional standard and existing medical knowledge. The health manpower needed to provide these services is the end product of the level or status so determined. Since biological need for services and manpower is determined without regard to price and economic demand, its use in analysis tends to ignore gaps in health services and facilities attributable to lack of financial resources, accessibility, interest, or knowledge on the part of the population in obtaining needed care. If manpower resources are not the constraint that causes utilization to be less than what is medically needed, such requirements estimates describe an ideal situation that may not be attainable in the real world of impediments and constraints.

Requirements estimates that take into account the use of money to purchase the goods and services to satisfy health needs--called "effective demand"--result in very different answers. It is only money and the willingness to use it for these purposes that make demand effective. "Demand" is an economic concept that refers to the quantities of goods and services that consumers are willing and able to buy at various prices. A fundamental characteristic of demand is the inverse relationship between price and quantity: As price increases, quantity demanded decreases, and vice versa. In the current instance, demand for health manpower is derived from the demand for health care services and from consumer ability and willingness to pay for these services. Although consumers may want to purchase certain services, which may be termed potential demand, they may not have the financial resources to do so. The willingness to consume goods or services does not by itself generate demand; only those who are willing and financially able to purchase are considered demanders. Requirements generated through use of a "demand" concept clearly differ from those that would be generated by a "need" concept.

Determination of "potential demand" can be still another concept or objective of requirements estimation. Potential demand may be said to exist when constraints on the supply of health services prevent consumers from purchasing services that they would otherwise use. In this case, effective demand is not evident in the market place, but only because suppliers are unable or unwilling to provide the services demanded. Potential demand for health services becomes effective only when the health care delivery system is <u>not under stress</u>. When demand pressures become excessive, mechanisms acting to reduce demand and thus restore equilibrium between demand and supply may emerge, such as increased money costs to the consumer, added inconvenience in obtaining care (non-money costs such as longer waiting times to appointment and in the physician's office), changes in case mix, lowered follow-up visit rates, and others. These mechanisms will continue to operate until the demand for service equals the supply of services and will, in significant measure, determine what kinds of services are delivered and the segment of the population that will

receive the care.

Still other characteristics of the health care delivery system have been and can be used in the estimation of health manpower requirements. The process and content of requirements estimation vary with the objectives for which the requirements are defined. One frequent objective of the estimation process is the determination of manpower required to maintain current levels of utilization. Utilization of health services is sometimes used as a proxy for effective demand, although the two differ according to the amount of unfilled demand which is not directly measurable. This "quasi effective" demand for services may be identified from utilization records, under the assumption that use of services indicates the level of consumer demand, including the perceived medical need and the willingness and ability of the consumer to pay for these services. In this approach, estimated health manpower requirements are derived from the estimate of utilization of (i.e., demand for) services. The utilization of services in turn is based upon the pattern of service utilization of each group of the population and the number and characteristics (e.g., age, sex, income) of the persons in that group. Specification of health manpower requirements to meet a population's medical needs, on the other hand, implies that health care should not be made available only to those who seek it or can afford it. Health care is thus considered a right rather than a privilege.

Time Frame of Health Manpower Requirements Estimates

an important dimension that must be clearly recognized and agreed upon in the development of health manpower requirements estimates is the time frame for which the estimates are being made. In simple terms, there are three general time categories for which requirements estimates can be made which, when selected may result in quite different estimates:! current, short-term, and long-term. There are important distinctions among these three time frames in that they may have a major impact on the requirements estimation. The time frame covered by the estimate or projection often determines not only the type and characteristics of the requirements methodology that should be used, but also affects the end result, the level of the requirement estimate itself.

To make estimates in a current time frame is simply to determine whether and where disequilibriums exist in the present system. This shows where there may be supply shortages or excesses, but since the time-frame is the present, there can be no meaningful correction or adjustment of the situation at that time. The usefulness of this time-frame is mainly to distinguish values for a base year, generally as a starting point for development of more meaningful short-term and long-term forecasts. Although development of such current estimates is not simple or easy by any means, it nonetheless often requires

fewer inputs, assumptions, etc., than do projections of requirements.

When forecasting the near future--the short-term--possible changes in a number of factors need to be considered--population, income, morbidity, mortality, etc. However, most aspects of the health care system must be assumed to be constant, since the time span for the estimator is generally too short for any major changes to be implemented or to take place. In the short-run, even the demand function tends to essentially remain fixed, meaning tastes and preferences will not have time to change drastically. Also, it may be necessary to assume there can be few major changes in population characteristics in terms of distribution by age, sex, income, and type of employment. This is especially important, in the health care system, because it relates not only to the incidence of disease but also to the patterns of seeking care.

Just as the demand function is relatively fixed in the short-term, so is the production function, i.e., the productivity of providers can change little and technology and professional knowledge can not improve substantially in this time frame. In the short-term, construction of new facilities can not be considered, and, since the education of health professionals is a lengthy process, the manpower supply must be considered as relatively inelastic. What can change, of course, is the price of health services, with nonprice rationing, such as queuing time for an appointment and wait time in the doctor's office, changing to meet requirements. Generally, short- term requirements analyses are useful largely in indicating a framework for reallocating existing resources, and can not properly assume major changes in the health care system that would make it more efficient, or more equitable.

In development of long-term requirements estimates, say to the year 1990 or 2000, most of the parameters that have to be held constant in short-term estimation may be allowed to change in long-term estimation. Assumptions may be introduced relative to the incidence of disease (e.g., from a medical breakthrough) or the proclivity to seek care, (e.g., through a consumer education program). Productivity may also be assumed to change through improved technology and medical knowledge. In long-term forecasting, the objective may be to estimate requirements under the most efficient and equitable arrangement of resources, taking account not only of existing resources and the possibility of creating additional ones, but also of the possibility of adjusting requirements or changing the system (which is discussed below). The effect thus is very different from the short-term; the emphasis here would be on planning for future resource needs, not just reallocating current ones.

Delivery System Characteristics

In determining requirements, assumptions must implicitly or explicitly be made as to what the characteristics of the health care system will be in the projection year. Estimates of requirements would be very different depending on the degree of changes that it is assumed will occur in the present system.

An example may clarify this point. The current system--composed of facilities, personnel, and their relationships to patients in the organization, administration and financing of health care services--has been predominantly one of independent, office-based physicians operating on a fee-for-service basis. Consumer and provider emphasis is heavily on the use of relatively expensive inpatient care since public and private health insurance have tended to finance this type of usage most fully. However, the expansion of demand and costs since 1965, and the prospects for further extension of health insurance have stimulated changes in the present system in the search for cost containment measures, and may stimulate even more changes in the future.

PSRO's and utilization review committees, along with local and State health planning agencies, also may bring about major changes in the system, although it is conceivable that these developments could bring about a more efficient health care system without drastically altering its present characteristics. There is little agreement, however, as to whether these developments will really become fully effective; therefore it is difficult to determine how great an impact on requirements they could ever have.

One important development has been the recent growth of Health Maintenance Organizations (HMO's) and group practices. Although HMO's have existed for over half a century, prior to 1970 they were not numerous enough to be seriously considered as a possible alternative to the present health delivery system. However, by the end of 1974 the number of HMO's had grown to 183, from thirty-three in 1971. Although HMO's take many forms, they have certain common characteristics: they are organized systems that provide a comprehensive range of health maintenance and treatment services to a voluntarily enrolled population in exchange for a fixed and prepaid periodic payment. Delivery of physicians' services on a fee-for-service basis through the offices of individual physicians differs in important ways from delivery of services through outpatient departments of hospitals or clinics of prepaid groups or HMO's. These differences influence not only the demand for services of various kinds but the number and occupational mix of the personnel providing them. Shifts in the utilization of services between inpatient and outpatient care or between treatment and prevention of illness, produce corresponding shifts in demand for health service personnel.

For example, one study of the impact of an increase in the number of HMO's on future manpower requirements found that fewer physicians and nurses but more eye care workers, dentists, health administrators and some allied health workers would be needed. 24/ Consequently long-range requirements projections need to consider impending or possible changes in the characteristics of the delivery system if the estimates are to be meaningful.

A further factor in developing physician requirements estimates that should be explicitly allowed for is the degree to which the supply of non-physician manpower is assumed to be available and utilized. There has been a steady growth in the number, type, and use of support personnel to assist doctors, thereby reducing physician requirements. Many of these professions require shorter training periods than medicine or nursing and therefore it is easier to expand their supply and less costly to utilize them, etc. These ancillary personnel could play a very important role in the future U.S. health care system, since studies have shown that they can increase productivity substantially. In practice, the advantages of their use is not generally understood or accepted. At either rate, requirements estimates for physicians need to recognize and state whatever assumption is made about the utilization of such new health workers. Clearly, an increase in the use of people in these occupations could alter the level of physician requirements substantially.

Conceptual and Definitional Constraints

As indicated earlier, requirements estimation can involve consideration of needs, demands, and other concepts. Even when these concepts are clearly described or recognized, definitional problems remain. The health needs approach to requirements focuses on the health status of the population in order to estimate manpower requirements on the basis of the care needed to attain or maintain good health. But a number of technical difficulties are associated with the health needs method, largely in defining and quantifying health needs, the proper modes of care and type of treatment for each health need, the time needed for the treatment, and the amount of service that individual physicians can be expected to provide. Physicians disagree about definitions and measurement standards; the population's health status changes over time; medical technology and practices change; assignments of responsibility and functions of health occupations change. In addition, the necessary statistical information is often out-of-date, incomplete, or inapplicable. The

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24/ U.S. DHEW, NIH, "HMO's...Their Potential Impact on Health Manpower Waid, John B. GEOMET Report No. HP239, Washington, D.C. Government Prnting Office, 1973.

needs method has its most serious limitation, however, in its failure to consider a patient's willingness or inability to seek care. This method essentially assumes that there are no financial or social constraints to seeking care, and that all medical care as noted by physicians will be sought by patients.

Another definitional constraint in estimating requirements for medical specialists is the problem of overlap among specialists in the services they provide. For example, although requirements for primary care physicians are generally estimated on the basis of the services provided by general practitioners, family practitioners, internists, pediatricians, and obstetricians/gynecologists, many such estimates exclude the services provided by OB/GYN's, while others exclude some or all of the services provided by pediatricians. In addition, other specialists provide varying amounts of primary care, and a considerable amount of surgery is performed by general practitioners (M.D.'s) and osteopathic physicians. 25/ Examination of the AMA data base--the most widely used source of information on physicians--shows clearly that whereas physicians who designate their primary specialty (in terms of hours of patient care) do provide full or part-time services in that specialty, they also provide services that are, by their own estimation clearly within the traditional province of another specialty. Thus, whether in terms of patient conditions, medical treatment, or procedures, there is considerable definitional overlap among specialists, an overlap which can not be adjusted without changing the way physicians view and report their activities.

Problems such as these impact heavily on the accuracy of counts of physicians and on the measurement of the services physicians provide. It is unrealistic to accept uncritically any specialty requirements that are based on the assumption that physicians reported in a particular specialty treat only patients or conditions appropriate to that specialty and that no physicians outside that specialty treat similar patients or conditions. In essence, this means that requirements estimates for one type of specialist can also be met by another type of specialist. On the other hand, such estimates are far from being useless since they reflect the way that care is currently provided. For example, specialty distributions based on hours spent by a physician in his primary and secondary specialties show little difference from distributions developed on the basis of a "primary

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25/ Surgery in the United States. A Summary Report of the Study of Surgical Services in the United States. Sponsored Jointly by the American College of Surgeons and the American Surgical Association, 1975.

specialty" measure. 26/

Still another definitional factor which makes it difficult to estimate requirements for specialists is the gradual movement of physicians from one specialty to another after their initial residency training or after several years of practice. Not only do general surgeons move to one of the surgical specialties and internists to one of the sub-specialties, some physicians provide services in an entirely different specialty than the one in which they were trained or had previously worked. Since the derivation of certain types of requirements estimates are heavily dependent on services actually being provided currently, such estimates are weakened by the degree to which the current supply of physicians is mis-classified. Data to quantify changes in services provided are limited.

One problem in estimating requirements for specialists is the difficulty encountered in the translation of manpower requirements by specialty into residency requirements, which is constrained by conceptual and definitional problems similar to those associated with the estimation of specialty requirements, as discussed above. Physicians may transfer from one specialty or subspecialty to another during their residency training period, which makes the allocation of residency positions in response to requirements for particular medical specialties a hazardous task. For example, a distribution of first-year residency positions does not reflect the possible shift later of physicians from general internal medicine to subspecialty residency programs such as gastroenterology or hematology. Also, a significant number of residents of all types now elect one year of training in primary care prior to beginning training in the surgical and other non-primary care specialties, largely as a result of the abolition of the freestanding internship in 1973. Moreover, as has been noted, part of the workload of specialties such as general surgery and dermatology could be classified as primary care, which would tend to bias downward the real requirements for primary care physicians.

Thus, requirements for primary care physicians that are based on the number being trained in primary care specialties, except for family practice, may differ from requirements for the numbers of physicians who could be expected to provide at least some primary care. It was recently reported from 1974 data, for example, that 25 percent of those completing general internal medical training entered the

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26/ A recent analysis of hours worked in different specialties by osteopathic physicians indicates that there is relatively little difference in the specialty distribution according to whether all D.O.'s are counted in their primary specialty or prorated according to hours spent in their primary and secondary specialty.

internal medical subspecialties, and about 7 percent of pediatric first year residents were reported as going into the subspecialties of pediatric allergy or pediatric cardiology. 27/

Allocating residency positions according to specialty requirements is made more uncertain by the prospects of graduate medical education programs undergoing major change. There is, for example, a desire on the part of some specialty boards to reinstate a broad first-year program in preparation for subsequent specialty-specific training. It has recently been recommended by the Liaison Committee on Graduate Medical Education that the number of available first-year GME options be reduced from about 41 to 2, these being a first-year medical experience and a first-year surgical experience. A physician may therefore receive such diverse training that he will have much more choice about what he does or what his specialty designation will be. The net effect of these changing requirements for the characteristics of training programs would be on the distribution of opportunities for training and specialization and the resources available, and the difficulty in making estimates of requirements for residency positions to match requirements for medical specialists will be much greater.

III. Theoretical and Practical Concepts for Quantification

Developing requirements estimates is difficult and complex at best, largely because of data gaps, state-of-the-art problems, and lack of consensus on what level of requirements is called for. Perhaps even more of a problem is the lack of agreement on what unit of measurement should be used in calculating requirements. Many different concepts can be and are used for quantifying requirements. Some of these are theoretically possible or preferable, but in a practical sense can not be implemented because of data or other problems. Others are too aggregate or too detailed to be properly comprehensive, while still others are usable but have conceptual problems which weaken their acceptability. In all cases, the need is for some measure or proxy of services provided (or needed) that can be used to estimate actual utilization of physician services, or ideal or proper requirements for services.

The volume of visits (patients seen) is one measure that can be related directly to the need for manpower. Actual utilization of services (visits) and the manpower providing them can be used as a proxy for effective demand, medical need, or utilization or any type of requirements. Given a specific level of productivity, a measure such as average daily patient visits can be used as the service

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27/ Memo from Brian Biles to Staff Committee on Labor and Public Welfare, U.S. Senate, on data on residency training. June 4, 1976.

concept from which manpower requirements may be obtained. Complexity of services provided, difficulty or diagnosis, or condition for which care is sought are all additional refinements of the visit concept. This measure, readily identified from utilization records, can easily be used as a measure of requirements if one assumes that the use of services indicates the level of consumer demand, defined as perceived medical need and the willingness and ability of the consumer to pay for services. Of course, the volume of visits should properly be based upon the pattern of service utilization of discrete groups in the population in order to fully measure health manpower requirements. It should also be tied, if possible, to specific individuals in the population to fully recognize the population based aspect of requirements.

As indicated, however, a more accurate visit-based measure of utilization of services would be one that adjusts such data on volume of visits for the relative difficulty of the services provided, the length of time required to perform the service, or the level of skill needed to perform it. Clearly, visits to a physician by a patient wishing consultation on a minor illness, by one seeking a general checkup, by one who is "worried well", or by one needing a surgical procedure are not equal visits for determining requirements for services. If feasible, a weighting procedure should be used to give greater weight to visits where more complex services or more time, are needed or higher costs occur. Another difficulty in using visits volume as the concept for quantification of manpower requirements is that the number of physician services performed in a single visit, even if approximately of equal time or complexity, could differ widely depending on tests run, assistants utilized, procedures performed, or physician practice. In such cases, total physician time might <u>not</u> be a better measure for quantification than simple number of office visits.

Another concept for possible quantification in estimating requirements is the diagnosis made or illness uncovered, or the patient's complaint. National Center for Health Statistics data, such as from the National Ambulatory Care Survey or Health Examination Survey yield data on numbers of specific diagnoses made by types of physicians in the office setting, as well as on the specific illnesses or other care needs that exist among the general population. National estimates of a specific number of health conditions or diagnoses as obtained or derived from these and other surveys can be related to a productivity level for a particular specialty or sub-specialty in order to obtain estimates of manpower requirements. One would have to know, of course, the actual or ideal physician specialists for these illnesses or conditions in order to utilize these data in developing requirements estimates. Using this method, one might then be able to relate, for example, the number of certain vision-related conditions in the general population to the actual or possible productivity of

ophthalmologists in treating these conditions, thereby deriving a requirements estimate.

An additional concept for possible measurement which is somewhat difficult to quantify is appropriateness of care. This means that no matter what concept is used, measurement should be made only of that care which is "appropriate." For example, SOSSUS and other studies have indicated that a great deal of unnecessary surgery may take place. Clearly, if only "necessary" surgery were to be performed and counted, the requirements for the surgical manpower would be substantially lower. From another perspective, physicians in many specialties may be performing services which might be more appropriately performed by those in a different specialty, by general or family practitioners, or even by non-physicians. An example might be a surgeon performing a general physical exam in an office setting or an ophthalmologist devoting a substantial proportion of his time to performing refractions. A measurement of services that took into account the relative appropriateness might therefore serve to increase requirements for one type of physician or non-physician manpower and decrease requirements for another type of manpower. NCHS Ambulatory Care survey data clearly show that most physicians in ambulatory care provide considerable care outside of their specialty. If all care were delivered in the "appropriate" manner or by the appropriate manpower type, or if only care that was "appropriate" were provided, requirements for manpower would be considerably different from those measured using a different concept. On the other hand, the provision of care outside a physician's specialty could well be serving a useful role, too, by "filling in" periods when demand for his specialty is low, thus contributing to a more efficient use of physician's time.

It is also possible to measure requirements on the basis of the cost of a visit. Variation in visit costs or charges for care may reflect differences in the orientation and training of physicians in various specialties as well as patient demand for their services and other factors. For example, the type of service provided and consequent charge rendered by an internist in the course of an initial office visit might differ considerably from the type of service and visit cost rendered by an orthopedic surgeon. Furthermore, since the categories of services which a visit encompasses may not be uniform, costs are likely to reflect quantity of services provided as well as price per service. It should be noted, too, that within a given specialty, there might be wide variation in such costs per visits. However, requirements could be derived by relating estimates of total expenditures by a segment of the population for a type of patient care service to estimated unit cost for that service.

There is a great deal of literature related to quality of care, 28/ which is closely related to appropriateness of care. The planning legislation (PL 93-641) further emphasizes that access to "quality" health care is a priority of the Federal Government, and one of the objectives of Health Systems Agencies is to increase the quality of the health services provided to residents of the service area. With the enactment of the PSRO provisions, professionally developed norms of care, diagnosis, and treatment based on typical patterns of practice ultimately may become aggregate measures of "quality" of care. Such measures could then theoretically be used to determine requirements of the population for care, which could then be translated into manpower requirements. However, the "quality" of a visit, a diagnosis, or a procedure is very difficult to quantify and even more difficult to relate to the specific manpower providing it. Thus, in developing requirements estimates, one is forced to assume that the quality of care provided by individual physicians or specialists is the same.

Although perhaps not the best measure of requirements, simple physician head counts are the most frequently used concept for measuring requirements. By implication, all physicians or all specialists are counted equally, and no differentiation is made among physicians in terms of hours of work, patients seen, assistants utilized, or other variables. Essentially in this approach all physicians are counted as equal and providing the same type, quality, etc. of care within a particular specialty. Depending on many considerations, however, some refinements such as those mentioned above can be developed. In general, this approach has been the one most often utilized, largely because of data problems in the other approaches. It is clearly more relevant, however, to utilize a measure of the actual amount and type of services provided by different specialists, such as hours of work per week, number of patient visits, or type of conditions treated, and a number of recent studies have moved in this direction.

Since many physicians devote part of their practice to a secondary specialty, a disaggregated "effort analysis" is especially important in accurately assessing the services currently being provided, required, or demanded. Since most specialists treat more than one type of disease or one part of the body, requirements for these physicians are at least partly interchangeable with requirements for other specialists. Also, since many specialists deliver some form or component of primary care , no matter how defined, there would be overlap in physician requirements that did not take this into account.

28/ DHEW, BHPRD "Guide to Data for Health Systems Planners" Health Planning Series, P95.

Any concept of requirements must also differentiate among the needs for patient care services and other medical services performed by physicians. Considerable numbers of active practitioners are engaged in activities such as teaching, research, and administration, in which they are not directly providing health care. Similarly, even among physicians providing patient care, several different practice settings may be involved--individual physician's offices, clinics, hospitals, etc. In each of these settings, different concepts and amounts of care are provided or required. Ideally, the manpower requirements estimates and the type and amount of services provided should take into account the difference in practice settings, such as mental health and community clinics, hospital outpatient departments, and industrial clinics. Similarly, care in hospitals is provided by full-time physician house staff, visiting staff, and interns and residents, (who spend some of their time in education and training). However, although the total services provided, patients seen, or hours worked by individual physicians in a hospital can be translated into some "full-time equivalent" measure, the physician providing these services must ultimately be viewed as a single unit (a person). Thus, mixed service requirements at some point must be translated into "physician" requirements; preferably, full-time equivalent physician measures can reasonably be used where data permit.

IV. Factors Affecting Requirements

In the most simple terms, there are only a few major factors that are taken into account in estimating requirements--demand factors and health care system changes. However, as indicated below, these major factors have many component parts.

Demand Factors

Although a number of discrete factors influence the demand for health manpower, the primary determinants that must be taken into account in estimating requirements are (1) the quantity and quality of health services demanded, which are conditional upon such factors as the population served, its health status, its perception of need for health care, prices and incomes, and the available supply of health manpower; and (2) productivity (output of services per person) of health manpower which is specific to the state of medical technology and to the health services delivery system.

The size and characteristics of the population are the basic determinants of the demand for health services and therefore for the demand for health manpower. Account must be taken not only of the number of people, but also of the proportions of the very young and the very old, the ethnic and racial composition (since some diseases are endemic to certain groups) and the urban-rural distribution. The

impact of age is especially critical for some professions or specialties, e.g., a population with an unusually high proportion of old people will require a higher than average number of physicians who specialize in geriatrics whereas a higher proportion of pediatricians would be required for a population with a high proportion of children.

Although all demand for health manpower is derived from demand for health services, the several determinants of demand affect different health fields differently. Some specialties are linked primarily to size and distribution of population; others (e.g., pediatricians) are linked to the age of the population and to birth rates. The demand for laboratory technicians, on the other hand, is strongly influenced by the development of biochemical technology and equipment. For purposes of analysis, it is important to recognize the specific dominant influences on the demand for manpower at the points in the delivery system which are being considered.

Demand is also strongly influenced by consumer income and by the price of health services. Changes in income and the consumer price of health services have been important factors in the sharp increase in demand over the past decade, as family incomes have risen and health insurance has lowered the effective price ("out of pocket cost") of services. In addition to the increases in demand for health care that have accompanied rising income, rising educational levels of the population have been accompanied by greater recognition of the importance and desirability of health care.

Requirements estimates must also take cognizance of the possible impact of the National Health Insurance program that appears probable in some form during the next few years. The lowering of financial barriers to care will shift the demand for medical services and for manpower upward, but not necessarily equally for all services. The differential impact on services and on manpower will reflect the coverage, beneficiary contributions, and provider reimbursement formulas that are adopted, on the one hand, and the price of demand, on the other. Because of uncertainties about the kind of National Health Insurance program that will finally emerge, and about the changes in utilization as consumers react to their lowered medical costs, the conceptual problems that demand estimators face in adjusting their manpower estimates for the impact of National Health Insurance are great.

The health status of the population obviously also affects demand for health services. It has, in fact, been suggested by some investigators that health status may well be the single strongest consumer-related determinant of health care utilization. For example, the declining prevalence of certain diseases may have an impact upon hospital admission rates, average length of stay of patients, and, ultimately, hospital bed needs.

Supply is also an important determinant of demand for health care. Effective demand for health care presupposes a supply of facilities and personnel; demand can be effective only if there are services to be purchased and providers from whom to purchase them. Moreover, the availability of health services as the consequence of the discovery and application of new medical and dental technology in itself generates a demand, as has been frequently seen. This is particularly true with the proliferation of specialized services. In the face of the consumer's imperfect knowledge, the physician becomes the professional adviser and plays a major role in deciding the amount of services to be consumed.

The influence of supply on demand is nowhere clearer than in health resources planning. Whenever services are limited by the unavailability of facilities or personnel (e.g., inadequate hospital capacity or lack of the full range of medical capabilities, etc.), the demand is reduced accordingly. A change in the availability of medical specialists thus would probably change the effective demand for services and personnel.

Health Care System Changes

In recent decades, new modes of delivery have emerged in the face of rising demands and rising costs. Discussed earlier was the Health Maintenance Organization (HMO), which, through economies of organization and scale, both encourages and facilitates combinations of medical and allied health personnel not feasible in the typical solo practice doctor's office. Similarly, hospital delivery systems are being modified in ways that alter staffing patterns and open new potentials for paramedical personnel. Outpatient departments and emergency rooms are being restructured and reorganized as primary providers. These modes of delivery lend themselves to team approaches with consequent opportunities for increased use of allied health personnel.

The transfer of functions from professional to paraprofessional--task delegation--is one of the major mechanisms for increasing the supply of medical services. In the last few years a spate of new occupations, collectively called "physician extenders," has emerged under such titles as physician assistant, clinical associate, nurse practitioner, and MEDEX. As these have more pertinence to some specialties than others, it is important to consider their impact differentially. Basic to the development of the physician assistant as a new health occupation, for example, is the assumption that the productivity of the physician can be increased, and that together the doctor and his assistant can or will deliver a significantly higher quantity of medical care, with no sacrifice of quality. No estimate of future requirements or supply of physicians can ignore the role of

the physician assistant and his impact on physician productivity. Unfortunately, though, the analysis of labor productivity in the health care sector has proved to be one of the more difficult tasks undertaken by researchers in this field. The cause of this difficulty is the uncertainty underlying the specification and measure of the "output" of medical personnel.

The estimation of the supply of services available from a given manpower supply requires explicit specification as to the delivery system for health care. The quantity and mix of services provided by a given number of physicians, nurses, and technicians through a delivery system based on physicians in solo practice will differ markedly from one provided through a system based on clinics, HMO's and hospital outpatient serivces. Even if the quality of care is assumed to be the same, there are differences in the utilization and productivity of manpower, as well as of capital. However, emphasis in requirements estimation should be on what will probably occur rather than upon theoretical measures of what productivity increases are possible.

Productivity increases may stem from technological advances as well as from the realignment of tasks. In fact, these two forces often go hand in hand. Technological improvements impact on requirements as well as on supply. In the recent past, in part as a result of technological and biomedical advances, an explosion of expectations has increased the demand for health services and compelled changes in the delivery system. New patterns of care brought about by technology and research call for new concepts in health personnel; new occupations and changes in existing occupations through increased specialization are probably the most direct manpower effect of technological advances.

Thus, in the determination of manpower requirements and in the evaluation of manpower requirements and supply, productivity is too important a consideration to be ignored. Faced by a lack of data, the analyst must rely on his best judgment to develop reasonable assumptions in his projections.

Legal constraints also affect requirements for health manpower. For many occupations, some form of credentialing is practiced--either licensing by the State as a prerequisite to practice or certification by a professional organization attesting to the completion of accredited education or training necessary to establish the qualifications of individuals. Credentialing requirements may constrain the supply of manpower in any locale by limiting the number eligible for employment and by preventing more efficient utilization of manpower. For example, the functions of the family nurse practitioner and the pediatric nurse practitioner may involve functions restricted by law to the physician. Many doctors are

thereby deterred from delegating duties to subordinates. A significant source of future supply may develop from the use of proficiency examinations as a basis for credentialing as an alternative to the completion of prescribed, accredited education.

The Federal Government has acted to lower the credentialing barriers by supporting the development of equivalency tests to permit persons with knowledge acquired on the job or through nonacademic routes to challenge course requirements and receive advanced standing, and thus reduce the time needed to achieve academic credentials.

V. Methodological Approaches to Requirements Estimation and Forecasting--Advantages and Disadvantages

There are many different approaches to and methods for estimating and forecasting health manpower requirements, ranging from the very simple physician/population ratio approach to the extremely complex and technical equilibrating and optimizing model approaches. Each of these approaches has real advantages; each of them also has potential problems and disadvantages. Because of this, a key step in any analysis of physician manpower is to define precisely the purpose of the analysis and to select and tailor the analytic approach so as to utilize its intrinsic strengths. The discussion below lists a number of the more common analytic methods available and summarizes the strengths, limitations, and problems associated with their use. It should be noted, however, that these approaches are not necessarily mutually exclusive. In many instances two or more approaches can be combined to yield a single satisfactory method. A more detailed description and discussion of methodological approaches can be found in Volume II, Practical Planning Manual, Methodological Approaches for Determining Health Manpower Supply and Requirements.

Manpower/Population Ratios and Utilization Models

The simplest way of estimating and forecasting requirements is to calculate the actual ratio of manpower to population and to compute the manpower required to meet this standard for another, different population. The ratio of one area can be used for another point in time, or a comparison can be made across both time and space. Also, other types of population standards can be employed, such as providers per population from a typical HMO. Simularly, visits or some other measure can also be related to population.

The overwhelming advantage of this approach is its operational and conceptual simplicity and the general availability of adequate data. The disadvantages are the unrealistic assumptions that population mix

and demand and manpower mix and productivity are either constant or change in a compensating manner. This approach also ignores the interaction of supply and demand, and such factors as dollar price which adjust supply and demand in the health care market.

The real issues of the tradeoffs between conflicting health care goals--those of limiting the inputs of scarce resources and minimizing the benefits of care and the social equity gains are too often ignored by the slavish and uncritical use of a ratio approach. Because there is no single "perfect" care system, the concept is empty unless it explicitly and forthrightly addresses the real issue of whether the care system implied by the ratios is desirable or not. Use of any such ratio assumes the same population, providers, prices, waits for care, and limits of care of the system from which it was drawn. The mechanically generated "shortage" or "surplus" based on this approach implies that there is only one possible care system, and this is clearly not the case. There are alternative systems, each of which may call for a different level of physician resources.

While attention must be paid to these and other limitations of the ratio approach, it does not mean that the ratio approach is useless. If the user of this approach recognizes the reasons for the choice or derivation of the ratio, the simplicity and clarity of the ratio approach recommend it.

Utilization models are very similar to population ratio approaches. Such models apply utilization rates to a population disaggregated by age, sex, income, etc. and then convert the total utilization to manpower through staffing or productivity rates. In effect, a pure utilization model--one which does not use trends or other information to change the utilization and staffing rates--is essentially the same as a manpower/population ratio approach except that the utilization model allows for differences in the population composition. Thus, most of the earlier comments about the ratio approach apply to utilization models as well.

Trend Analysis and Trend Models

Another relatively simple approach involves the use of trends in care utilization and staffing rates, generally as modifications to a utilization model. While this approach may attempt to adjust for future changes in these factors, there is a serious methodological error in projecting these trends. When both care demand and staffing proxies are measured using historical utilization trends, the equation is reduced to nothing more than the trend in the manpower/population

ratio. 29/

Possible choices for avoiding this error are not attractive. One choice is to estimate "true" demand and supply from utilization through economic analysis, which is frequently quite difficult. The other choice is to base the trend for at least care demands upon some basis other than historical experience. 30/ Due to these constraints however, the trend approach is limited in its usefulness.

Professional Judgment Approaches

The professional judgment approach usually involves estimation of the population's "ideal" or "acceptable" care requirements, and the translation of these requirements into manpower workload and requirements. Most often it is based on a manpower/population ratio, although it may also utilize services, visits, or diseases. Although the process can employ empirical data as a framework, the strength of this approach is that it bypasses the difficult problems of quantification of the "proper" level of requirements, ideally obtaining an "expert" answer that balances many unquantifiable considerations. The problem with the approach is that it usually cannot be adequately justified or effectively discussed-- one can only accept or reject the expert's opinion. Beyond this is the problem that experts on health care normally are not capable judges of the

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29/ If the trend in "demand" is estimated as the trend in utilization (UTIL) divided by the trend in population (TPOP), and "productivity" as the same utilization trend divided by the trend in providers (TPROV), the equation yielding the future provider requirement (FPROV) from these factors and the future population (POP) is:

$$FPROV = POP * [(UTIL/TPOP)/(UTIL/TPROV)]$$

which reduces and rearranges to:

$$FPROV = POP * TPROV/TPOP$$

This is because past utilization represents adjustment of the demand and supply of care to each other in the market context to yield actual utilization; consequently, utilization cannot be used as a proxy for both. Unfortunately, many health manpower studies unintentionally contain this error.

30/ The limited evidence suggests that supply is inelastic to the market, thus permitting the assumption that utilization approximates supply in the past.

market, and consequently a "care needs" concept is substituted for a "demand" concept.

Econometric Model Approaches

Approaches utilizing equilibrating models include a wide variety of models which attempt to estimate how supply and demand adjust to each other through such rationing mechanisms as dollar price, to result in utilization. They range from relatively simple models of six, eight or ten mathematical equations, up to very complex models of more than one hundred equations. Generally, these models attempt to quantify the amount of change in care demands or supply that result from price changes using a ratio of change referred to as "elasticity." These elasticity estimates are then combined into a model that attempts to explain or predict how the health care system reaches a new balance after some outside influence changes it (such as a change in health insurance).

The obvious strength of this approach is that it attempts to directly quantify the key relationships that result in utilization. This focuses attention on factors that too frequently are ignored. The disadvantages of the approach are the extreme difficulty of quantifying and specifying the model . There is also often a lack of clarity as to exactly what the model does and how it does it. Such models take much longer to develop and have much more extensive data requirements than the others mentioned.

Existing models which attempt to estimate market equilibration can be sub-divided into three broad groups. One group, the classical econometric model, deals with the care market at the "macro" level, that is, it does not break out the analysis to individual units or small groups of units; it solves the equations of the model simultaneously. In contrast to other equilibrating models, classical econometric models require less data and can develop more accurate estimates of the variables and interactions of the model. The summary treatment, however, may obscure important relationships and the simultaneous solution is often difficult to stabilize and has trouble with non-linear relationships.

A second, less-accepted type of model is termed Systems Dynamics. These models also operate at the macro level, but they postulate a large structure of feedback loops and have many variables. Its proponents argue that the difficulty in quantifying the variables and relationships is not critical because the models are largely determined by the large number of feedback loops and their direction. Another difference is that the models use differential equations for solution, treating all of the processes as continuous flows and estimating longer time periods by breaking them into many small time periods. Repeated estimations and the feedback loops then cause the

model to equilibrate.

A third group of models are the simulation models, which analyz at the level of individual patients and care providers. Th se mod s Markovian, estimating the probability of each of a numbe of discret events occurring, and normally employ randomness in their computations. Estimates for a system are derived from sending large numbers of individual cases through the model. Because of the entry of randomness into these models, the final solutions are also random and the model needs to be run a number of times to estimate the most probable solution. These models have very extensive data requirements, and consequently are normally used to analyze limited systems such as individual medical practices or clinics. Occasionally, however, they have been used to model large systems where considerable detail is sought on the characteristics of the final stage. One such use is in the forecasting of population for the purpose of estimating future care demands. The advantages of microsimulation are the large amount of information available for the forecast time period and the clarity of the model, which permits an easy understanding of the model's assumptions and interactions. The disadvantages are the large amount of detailed data required and the high computer costs of running a large microsimulation model.

Optimizing Models

Another approach to estimation is the use of models (usually linear) which optimize to a specified objective subject to constraints. This type of computer model solves for a "best solution" that maximizes some utility or minimizes some cost. Its principal strength is that it provides a clear solution, provided the objective to be optimized can be specified. The major disadvantage is that only a fraction of the major health questions can be answered through optimization techniques. Too frequently, it is not possible to state a single objective function that should be optimized and when it is possible, the models tend to be normative with little objective support. Also, this approach extends minor differences to their logical extreme, and minor misspecification can be magnified into absurd results.

International Comparison Approaches

Occasionally health manpower requirements are approached through comparison with the health care systems of other nations. Often these attempts compare physician population ratios and mortality rates between nations. While perhaps superficially useful, the conclusions too frequently ignore or understress the vast differences in environment, population type, homogeneity, and density, care delivery organization, cultural differences and the like.

A more valid use of international comparison is the analysis to a specific change in a foreign system, where specific implications can be drawn.

VI. State-of-the-Art and Available Requirements Estimates

A major purpose of the preceding section has been to suggest that there is no single ideal approach to the estimation or forecasting of graduate medical education requirements; rather, that there are many choices that can be made, all of which have strengths and shortcomings. However, because these approaches are not necessarily mutually exclusive, some of them can be used together. It is possible to merge several techniques to obtain a hybrid approach that minimizes the weaknesses inherent in any one approach. It should be emphasized however, that the development of an acceptable approach tailored to the issues and problems of GME requirements estimation will demand time, money, staff, and ingenuity. Possible directions to consider for this effort will be discussed later in the section on research needs. In this section some of the general problems that have confronted analysts of the health care system in the past, are described. The section concludes with a brief review of some of the actual requirements estimates developed in recent years.

State of the Art of Manpower Requirements Estimation

One of the major roadblocks in estimation of manpower requirements is the problem of data. Needed data are often simply not available. Data that are available may have inconsistencies in definition, differences in coverage, or inconsistent timing in collection. The state-of-the-art often does not permit proper utilization of existing data, so data may have to be tailored to the existing methodology by which the estimates are to be made. In addition, it may not be clear as to how existing data can be utilized, and how various parameters are to be accounted for by inadequate data.

Reasonable estimates of requirements for health manpower may be and have been developed. However, with regard to each field of analysis, statistics are often limited; for example, data on health care needs, services used, medical expenditures, labor productivity, the personal characteristics of workers and their relative wages are either unavailable or outdated. Not only are current data missing, but reliable information about past trends may not exist, and what is available may not be consistent or comparable over time as a result of different definitions, coverage, time span and data collection methods. An even more difficult data problem is that data are often discrete, separate, and not reliable. For example, data on patients

seen by physicians are separate from data on physician visits made by the population.

The complexity of the health care system in the U.S. also poses problems. Health care is delivered by a wide spectrum of providers and in a wide variety of settings, and these providers and settings are not linked together in any systematic way. They operate independently and autonomously, each being responsible for only a small portion of what might be called the "total care" of the patient. On the other hand, the interrelatedness or overlap of the job content of many health care workers often poses different problems. The proliferation of specialties and occupations has created an increasingly complex relationship of complementarity and substitutability among health occupations.

Non-comparable assumptions and objectives often defeat even the best analysts. Data must be obtained from different sources and bits and pieces put together, not always consistently. Definitions used and coverage included may not be comparable. When not entirely comparable data must be used, adjustments must be made that will improve comparability or bring about a recognition of the sensitivity of the noncomparability. The gaps in such data that do exist make the proper utilization of such data even more difficult.

The lack of consensus on various estimation parameters is clearly reflected when different requirements studies are examined. No simple guidelines consensus exists about the most appropriate methodology for projecting or estimating requirements, and even the most knowledgable expert analysts disagree. The lack of agreement reflects the general lack of knowledge about the forces influencing the demand for health care, about the conversion of that demand into manpower requirements, and about the response that supply is capable of making to changing circumstances. It also reflects differing opinions about concepts and definitions. Even when there is agreement on factors that must be measured, there is often a large gap in the knowledge of how best to proceed. For example, we know that head counts by discrete occupations are misleading; that the health professions function in a complex web of complementarity and substitutability. But we do not have operationally practical techniques to measure the manpower input in terms of health teams or staffing patterns, and to measure the trade-offs. As we have seen, there is also no accepted method of measuring the output of health workers, nor on the output to be measured--visits, hours, expenditures, income, etc. In other words, there are inadequate input and output measures to translate accurately the manpower demand and supply into the demand and supply of services and vice versa.

Estimates of current requirements are difficult enough; however, projections of requirements are even more difficult in that they must encompass a wide variety of factors not inherent in estimates of current requirements.

Requirements projections depend on many alternative assumptions about a large number of factors. The resulting combinations can lead to a multitude of alternative estimates, no single one of which is the "best" estimate for all purposes. A range of estimates is needed in order to provide reasonable alternative possibilities for planning and policy determination, since the particular assumptions made for each element in the projection of health manpower are so important in determining the outcome. Key assumptions may relate to changes in characteristics of the population, changes in services demanded, changes in practitioner productivity, impact of changes in health care delivery system and in payment for services. To be acceptable to persons other than the developers, the estimates of requirements must clearly describe the assumptions.

Finally, in addition to the broad forces operating nationwide, local factors and their effect upon health manpower must be examined to obtain accurate estimates. The needed data which would permit adequate assessment of such local factors are simply not available, and the likelihood of obtaining the needed data in the near future is remote.

The picture is not entirely bleak, however. While an extensive review of possible sources of data must be part of the GMENAC effort itself, the availability of some recently developed data sources deserves mention here. The most important for GMENAC purposes is the National Ambulatory Medical Care Survey, conducted by the National Center for Health Statistics. Covering a sample of all office-based physicians, this survey provides data on the type of patient complaints and the physician diagnosis for a sample of patients. It also contains data on the length of the visit, the physican's judgment of the complaint's seriousness, and the treatments given. Combined with the data from the Study of Surgical Services in the U.S., an adequate picture of the content of the care provided by different specialties could be obtained. For the specialty studies that have not been completed, the very extensive U.S.C.-Mendenhall effort could provide further information.

For the primary care specialties, the Mathematica Resurvey of Primary Care Physicians effort provides important data on the productivity factors and the responsiveness of the primary care physician to changes in demand for his services. For two points in time, this survey measures 210 geographic health care markets and collects data on individual practices. Data elements include the wait for

appointment, the limitation of the acceptance of new patients, the wait in the physician's offices, the hours worked by the physician, the number and type of aides employed, the basic fee, the number of examining rooms, and the number of patient visits. The forthcoming BHM analysis of these data is being directed at measuring the changes in physician practices in relation to the changes in their market environment. Data from the first cycle of these surveys have also been combined with extensive data from other sources, including the NCHS Health Interview Survey, to give an extensive data set for the 22 largest U.S. metropolitan areas.

The American Medical Association data base is increasingly being provided for statistical purposes and it will probably be possible to obtain limited tabulations of data from the AMA Master File. This file contains data on the physician's primary, secondary, and tertiary specialty, his Board Certification status, and his training, as well as his age, sex, and location. Information from the AMA analysis of full-time equivalency by specialty, and data from the Periodic Surveys of Physicians might also be obtainable. Finally, preliminary data from the RAND National Health Insurance Experiment may soon be available. The Experiment utilizes a sample of the population in selected areas with specified health insurance coverage. While still in the early stages of a five year data collection effort, it might provide preliminary estimates of important factors affecting the demand for care, such as the combined efforts of income and insurance coverage and the role of morbidity in the creation of demand.

Current Estimates of Medical Specialist Requirements

Despite the problems outlined above, requirements estimates for medical specialists and other physicians are being and have been developed, and many of them appear to serve adequately as indicators of requirements. However, estimates of total medical specialist requirements have been developed and are available from only a limited number of sources, such as the project SOAR model developed by the Manpower Analysis Branch, BHM. Some total physician estimates are available from the Bureau of Labor Statistics. However, an increasing number of specialty-specific requirements estimates have been made in recent years. Results from some of these activities are presented below.

SOAR Requirements Model: The current, first generation requirements model of the Manpower Analysis Branch was originally developed on a crash basis as part of project SOAR (Supply, Output and Requirements). It sought to respond to the question, "How much manpower will be required by the future health care system under certain specific assumptions?"

Constrained by time, resources, and available data, the developers selected the demographic projection method as the best way to respond to immediate questions on future manpower requirements. Using this method in the SOAR requirements model, U.S. population by age, sex, and income class was projected for 1980, 1985, and 1990. For each population subgroup, a utilization rate of each of 18 types of care (e.g., office visit, inpatient visit, nursing home stay, etc.) was estimated from the National Health Interview Survey (HIS) data. Based on different assumptions as to what utilization will be, a projection of the total population's utilization of care in each of the three target years (1980, 85, and 90) was obtained by cross-multiplying the projected size of each population subgroup by its associated utilization rate. In order to convert this to manpower requirements, the number of manpower observed to be associated with each of the 18 care types in the base year was compared to the amount of care utilized in that year (estimated by cross multiplying population by utilization rates). This ratio was then multiplied by the projected utilization rates for 1980, 1985, and 1990. After minor arithmetic manipulation, the desired projections of manpower requirements emerged. The specific medical specialties included in the projection matrix are: General care, pediatric, obstetrics/gynecology, ophthalmology, psychiatry, surgery, secondary specialists and "noncare" specialists.

Making the simplifying assumption that care utilization and productivity remain constant over time, the SOAR model has been used to generate preliminary estimates of physician requirements by care setting between 1970 and 1990. As shown in the table below, overall requirements for physicians of all types were projected to increase from 1970 to 1980 by almost 10 percent. In this period, requirements for allopathic physicians were estimated to increase by more than 9 percent; general care physicians by 10 percent; ophthalmologists by 16 percent; psychiatrists by 15 percent; surgeons by 7 percent; and secondary specialists by 11 percent.

The SOAR requirements model has also been used to assess the short term impact of various forms of National Health Insurance on requirements for health manpower. Most of the plans considered for analysis have been archetypal in nature; that is, corresponding only in general to specific legislative proposals in Congress.

Assuming the adoption in 1980 of a comprehensive NHI plan representing the middle ranges of most NHI bills, the following projections of requirements for physicians from 1970 to 1980 have been made: Overall requirements for physicians were estimated to increase by 23 percent; general care physicians by 16 percent; pediatricians by 22 percent; OB/GYN care by 32 percent; psychiatrists by 30 percent; surgeons by 22 percent; and secondary specialists by 28 percent. The SOAR model is currently being revised and new, more detailed estimates are expected

Estimated number of physicians in selected care settings (1970) and projected requirements for 1980 by specialty

Physician specialty	Total		Medical office		Short-term hosital		Long-term hospital		Vision care		All other	
	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980
All physicians (M.D. & D.O.)....	322845	353394	146641	165349	115316	122501	13937	16431	7603	9025	39348	40088
Physicians (M.D.).....	310845	340111	136711	154245	113776	120897	13797	16267	7493	8894	39068	39808
General.....	112305	123734	76138	84956	20006	20878	8373	9856	--	--	7789	8044
Pediatric.....	17941	17858	10520	10142	5242	5513	276	300	--	--	1903	1903
Obstetrics/Gynecology...	18376	21393	13910	16141	3977	4263	--	--	--	--	989	989
Ophthalmology.....	9927	11476	169	184	1851	1984	--	--	7493	8894	414	414
Psychiatry.....	23236	26823	11383	13956	3432	3483	5148	6111	--	--	3273	3273
Surgery.....	68099	72896	3601	3992	61193	65599	--	--	--	--	3305	3305
Secondary specialist....	42243	46840	20990	24874	12435	13148	--	--	--	--	8818	8818
Noncare specialist.....	18217	19091	--	--	5640	6029	--	--	--	--	12577	13062
Physicians (D.O.).....	12000	13283	9930	11104	1540	1604	140	164	110	131	280	280

Source: Unpublished data from the Manpower Analysis Branch.

Note: '--' = none.

to be available in spring, 1977.

BLS Industry-Occupational Matrix: The Bureau of Labor Statistics has developed estimates in which the health service industry is viewed in the context of the total economy and health manpower in the context of the manpower stock required to produce all the goods and services demanded by the community. This matrix method estimates future manpower requirements on the basis of an industry-occupational employment matrix that shows the percent distribution of an occupation's employment by occupation. Given the total labor force, employment in each industry and each occupational category in the matrix is derived.

The Bureau of Labor Statistics projected the National Industry-Occupational Employment Matrix to 1980 on the basis of historical trends, using various statistical and other analytic techniques. A number of states have also prepared industry-occupational matrices. However, the BLS industry-occupational employment matrix approach does not break out projected increases in the number of physicians by specialty or any other categorization. As derived from the matrix, requirements for physicians (MD's and DO's) are expected to increase by 47 percent between 1972 and 1985.

Medical Specialty Studies

As stated earlier, during the 1970's a number of physician manpower studies were conducted usually by or for specialty societies. Some of the results of these studies are described below.

An immediate shortage of orthopedists was defined by the American Academy of Orthopedic Surgeons. 31/ At the time of the study, the orthopedist--population ratio was 1:43,000. An optimal ratio decided upon by the specialty was 1:22,000. Thus a near doubling of orthopedists was recommended.

The American Thoracic Society and the American College of Chest physicians estimated 2,471 physicians in this specialty; 32/ an additional 4,327 would be required within two years to fulfill physician manpower goals established by the profession. This would raise the number of pulmonary disease physicians to 6,798, a 175 percent increase. The perceived increasing importance of chest disease morbidity and mortality was cited as the major reason for the

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31/ American Academy of Orthopedic Surgeons. Op. cit.

32/ Manpower Survey Committee of the American Thoracic Society and the American College of Chest Physicians., OP.CIT

increase.

Adams and Mendenhall (33/) found that the 10,691 cardiologists in active practice in the U.S. spent an average of about 50 percent of their professional time in treating heart disease patients. They recommended an increase of 4,600 (43 percent) in the number of cardiologists over the next five years.

The American College of Radiology Task Force (34/) found that the number of diagnostic radiologists appeared adequate for U.S. needs and no reduction in the number of residents was indicated. However, a shortage of therapeutic radiologists was noted with a recommended increase of 1,500-2,000 needed at present. A shortage was also believed to exist in nuclear medicine with only half the number needed currently available. Additional future shortages of physicians in pediatric radiology, cardiac radiology and vascular radiology were cited if additional manpower were not attracted to these sub-specialties.

At the time of the survey by the American Council of Otolaryngology (35/), 5,584 physicians in the U.S. were otolaryngologists. Of this total, 981 were residents. Because of increased demand perceived by the profession for patient care in this specialty, it was estimated that there was an immediate unmet need for 500 (11 percent) additional practicing otolaryngologists.

The National Thoracic Surgery Manpower Study (36/) identified 4,744 surgeons as practicing thoracic surgery. The study concluded that the replacement and distribution of thoracic surgeons appeared adequate under the then present system.

The SOSSUS (Study on Surgical Services for the United States) (37/) Manpower Subcommittee recommended a reduction in the number of physicians doing operations, to be achieved by a reduction in number of surgical residents.

33/ Adams F.H. and Mendenhall R.C. Op. cit.

34/ American College of Radiology Task Force on Manpower and Facilities. Op. cit.

35/ The American Council of Otolaryngology: Manpower Resources and Needs in Otolaryngology. Annal of Otology, Rhinology and Otolaryngology. 85-196, Supplement 24, Part 2, January-February 1976.

36/ Brewer L.A., Ferguson J.B. et. al. Op. cit.

37/ Study on Surgical Services for the United States. Op. cit.

The Subcommittee for Training of the Committee for Radiation Therapy Studies (38/) found that the increased utilization of radiation therapy techniques and a changing pattern in practice of radiology indicated an increased need for radiation therapists. The Subcommittee estimated that 2,080 full-time radiation therapists were needed, based on the WHO definition of maximum acceptable case load for a clinical radiation therapist practicing in an ideal setting.

The American Academy of Dermatology (39/) estimated a deficit of 1.1 dermatologists per 100,000 population, or about 2,300 more than the national total of 4,500.

VII. Development of a Research Strategy

The task of developing improved requirements projections is exceedingly complex and has many facets. The present state-of-the-art in requirements analysis is that the problems and complications of understanding the health care system are becoming apparent, while methodologies and data sources to do so are in rudimentary stages of development. We have begun to understand the degree of interaction of components of the health care system and we have a tentative understanding of how some of these interrelationships may function. The quantifications of these relationships are for the most part still very crude, however. This, together with the precariousness associated with any forecast of the future, means that any requirements analyses will necessarily contain a high degree of uncertainty. Adequate estimation of requirements for medical specialists also necessitates important normative judgments which cannot be adequately supported by present knowledge. While it is perhaps possible to identify extreme conditions where "overdoctoring" or surpluses of particular specialties exist or where obvious "underdoctoring" and shortages exist, these identifications are far simpler than identification of the "proper" amount of care that should be available. To identify the level of care that is undesirable, all that is required is a demonstration that the situation is worse than some standard that all can agree is undesirable. To identify a desirable level of care, on the other hand, requires consideration of all the issues associated with possible choices between cost, benefits, and social equity. Who is to decide what is the most desirable amount of services? With health insurance increasingly reducing the economic basis for decisions on the "worth" of health care, how best can a valid social decision be made on the allocation

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38/ The Subcommittee for Training of the Committee for Radiation Therapy Studies. Crisis in Radiation Therapy and Pactice Final report to National Cancer Institute, September 1972.

39/ Krasmer M., Ramsy D.L. et. al. Op. cit.

of resources to health care versus other social goals? The underlying problem is that we have no good measure of "acceptable" health care--nor is there an obvious, agreed-upon basis for deciding how it should be determined.

The Roles of Short and Long-Term Analysis

Long-term analysis permits the development of analytic capability, the collection of data and the conducting of studies to quantify important factors that are currently highly uncertain. Because solid research and collection of data require several years, short-term analysis using only existing resources over eighteen months to two years must be mounted; long-term efforts by their very nature generally must extend well beyond that time frame.

For long-term efforts to be targeted and effective, it is important that the general design of the methodology in which the results are to be used provide the basis for selecting the long-term research. Ideally, this should be a single analytic methodology which can adequately serve short-term needs and is adaptable to elaboration and refinement as the greater capabilities of the long-term research efforts are realized. Although this is not often feasible, it is nonetheless desirable that both short and long-term research be thought of as a coherent whole. Beyond permitting closer targeting of long-term research, integration of short and long-term efforts provides a rationale for more cautious and conservative short-term policy action.

An important part of a short-term research strategy is to address immediately the many factors which affect specialty and graduate medical education requirements. While the preceding sections of this paper have primarily emphasized the variety and complexity of some of the major issues and difficulties associated with their quantification, they have hopefully also shown the need for explicit treatment and consideration of the sensitivity of analyses to the uncertainties present in their components. This not only provides a basis for judging the importance of possible long-term research, but

gives some insights into the extent to which it may be presently possible to make policy decisions to change the structure of graduate medical education. In the short-term, policy action can still address what are judged to be undesirable specialty configurations. That is, without attempting a final, definitive identification of what is desirable medical care, situations that clearly are not desirable can be identified and addressed.

In view of the uncertainty in requirements quantification, perhaps a reasonable ultimate objective of a new improved requirements methodology might be the development of a graduate medical education strategy, rather than provision of definitive quantitative answers for years ahead. This becomes possible even with high degrees of uncertainty in the analysis.

The Structuring of an Analytic Approach

The structuring of an analytic approach requires 1) a decision on whether to use a single model or several component models and 2) a decision on what elements to include in the quantification. Single models without severable components are often necessary because the interrelationships of the factors to be analyzed prohibits analysis of one section of the problem at a time. However, this type of model has one very serious disadvantage--it is unclear just what is happening within the model. Because clarity is very important to the evaluation and acceptance of an analysis, it is generally desirable to sever the analysis into a number of component parts, if possible, thus permitting each component to become clearer and more comprehensible. In the case of graduate medical education requirements, it is probably more sound theoretically to treat the problem as a single entity, since the supply and demand for specialty care undoubtedly equilibrate in a market context. And, the shortage of one specialty tends to reduce patient demand for that specialty through rising prices and long waits for care, and increase demands for other specialties. practical sense, however, it is highly unlikely that such interactions can be quantified in the immediate future, and it therefore would be better to subdivide a less realistic methodology into component models for the purposes of clarity.

The first decision on the elements of the quantification should be tied to its objective. While the care needs of the population is an important concept to consider, future medical specialty requirements should reflect the care that will actually be sought. Primary emphasis should be on estimating care demands, although care needs should be considered as a partial determinant of probable demand levels. While the effect of care on health status could provide an ultimate goal for specialist requirements estimates, this is an unrealizable ideal at this time.

Similarly, the quantification needs to be in terms of the characteristics of the health care system that will actually exist in the future. To omit an important element due to quantification difficulties is to assume that it will have no appreciable impact. Unless this is thought to be the case, exclusion can create a greater error than inclusion, particularly when inclusion is expressed as a range of possibilities. The approach thus should address such care demand factors as the existence of a present shortage, changes in the population's size and composition, potential changes in the population's health status and need for care, and changes in the practice of specialties including aides and workhours, interspecialty overlaps in services provided, the impact of group practices, and legal constraints, among others.

The last important group of decisions that is needed relates to the units of quantification to be used. Here, the most feasible unit will probably be patient visit volume because of the ways in which data are collected. One useful adjustment might be to allow for differences between visits in terms of time or skill required. An alternative might be to use fees or dollar charges to reflect these differences, although there are a number of possible contaminating factors that might enter into fee differences that would not be desired in the quantification of utilization. Another alternative that could be investigated is the potential weighting of utilization to reflect the appropriateness or desirability of the care utilization as a partial approach to the issue of care "quality". For instance, different weights might be assigned to care provided by a board certified specialist, a non- certified specialist, and a specialist providing care outside of his specialty.

Development of an Illustrative Methodology

The methodology described below, developed especially for GMENAC's consideration, is presented as a simplified illustration of how one might go about developing a methodological design that attempted to minimize known problems, and is not intended as a recommended methodology. Since GMENAC may find it useful to design its own methodology, the purpose of the example is only to provide insight intc the process, not to develop a specific model.

As indicated earlier above, a statement of the objectives of the demonstration model is crucial. In this case, the model perhaps should: 1) Permit easy expression of the many important factors discussed above; 2) Permit use of existing data while still being amenable to improvement as better data become available; 3) Focus attention on alternative policies rather than point to a single definitive answer; and 4) Provide a clear and not overly technical model that can be understood and followed easily.

The early conceptualization of the model would consist of weighing data and knowledge limitations and possible analytic approaches in view of its stated objectives. The components of the overall problem are population care requirements, their translation into specialist requirements, and the development of possible GME configurations. For most accurate portrayal of the highly interactive health care system, a single interactive model without severable components would be required; however, a single equilibrating model is not possible at the level of detail of individual specialties and will not be available for some time.

The best structure for the population care requirements component would appear to be some type of utilization model. The population would be divided into groups by their important characteristics (certainly age, sex, and income, andpossibly other characteristics such as the presence of a chronic disease)and present utilization in patient visits estimated for the different specialties that provide patient care. Other specialties would be estimated in a separate model, perhaps by their relationship to the patient care specialties. The population would be forecast, and a preliminary patient care requirement obtained. The factors that affect patient care requirements would then be separately quantified as percentage changes in care requirements for individual population groups and entered into the model as ratio factors. The advantage of this approach is that the impact of each of the factors is determined independently and it is thus clear just what is occurring within the model. Instead of patient visits for units, dollar utilization or specialist hours could be used.

Several notes of caution are required here, however. The seemingly simple step of forecasting the population is quite difficult, particularly when income is introduced. This step should be determined before much work is done in other areas because of this difficulty. It should also be realized that when income is included, the shift of population to higher income groups infers that the future population will take on the characteristics of those higher income groups--that is, they will be less ill than the poorer populations, but will have higher utilization in proportion to their morbidity. Better care for the population is thus implied by this income shift.

The analyses of the factors affecting the population's requirements for care should begin with an evaluation of whether there is a current (base-year) shortage of the specialty that may be suppressing utilization levels. There is no irrefutable measure that proves this is so, but there are a number of indicators that need to be examined further. Rates of fee increases, the proportion of a particular type of specialty care that is also provided by other specialists, the demand for residency training, and waits for appointments can be suggestive of shortages, and other measures undoubtedly exist.

Professional judgment supported by information on these measures could be the best way to quantify this, and several alternative series of estimates should be employed.

Since the effects of income could be present in the preliminary quantification above, only two economic effects might be worth consideration in this illustrative model. One is the effect of changes in health insurance, particularly the possibility of enactment of National Health Insurance. A simple econometric type analysis utilizing alternative existing estimates of elasticity of demand or the simple adaptation of results from existing studies could quantify this factor. The second is the effect of changes in access to care. If maldistribution problems are successfully addressed over the next decade, that part of the population that now faces access problems that limit care utilization would not experience as great problems in the future and would increase their utilization. A possible quantification of this would be a comparison of matched populations that differ in accessibility to care and the estimation of the percentage increase that was associated with better access. Finally, some consideration should be given to changes in morbidity and health care technology that might cause shifts in the demand for specialists, such as changes in the incidence of cancer.

In the translation of care requirements into requirements for different specialties, the factors affecting productivity in each specialty can be treated in much the same way as the estimation of care requirements. The employment of aides, hours of work, the pace of work, and the effects of group practice trends can be introduced as modifications to a base-year production of care for each specialty. It is important here, as well as in the estimation of care requirements above, to forecast these effects with as little reliance upon past utilization trends as possible. Otherwise, the error mentioned earlier in the discussion of trend forecasting would occur.

At this point, the methodology would have provided an estimate of the specialty care required in service terms, which must then be translated into manpower. However, the question of interspecialty overlaps in the provision of these services then arises. It is known that specialists frequently provide care services outside of their designated specialty, and it may be desirable to re-allocate at least some of these cross-specialty services to the proper specialty. At the same time, an actual shift of this type in the real world cannot be made quickly. Furthermore, a change in one specialty causes shifts in the work-loads of other specialties in a cascading fashion. Thus, the best approach for this type of complex, interactive situation would seem to be an "optimizing" model. Such a model would take the total requirement for specialty services by type, the initial mix of service provision, the possible rate of change in decreasing cross-specialty service provision, and the measures of the

desirability of each specialty providing a given type of specialty service, and solve the problem given the constraints and the values placed upon cross-specialty care provision.

The optimizing model is also the logical choice for the third major component, the translation of specialist requirements into the "best" GME configuration. 40/ Here the base inputs would be the desired specialist supply for each future year, the expected surviving specialists for those years from those now practicing, and the initial GME configuration. The constraints would take the form of maximum rates of increase and decrease for GME programs. The optimizing function would have to specify the values to be associated with opening or closing a GME place and with having too many or too few of a specialty in any given year. To obtain a solution, the model would also have to be given a basis for comparing the cost of missing the target specialty mix as opposed to the cost of disrupting the GME system through opening and closing training positions. Where the previous optimizing model determined the specialist requirement for each year based upon computing a "value score" for that year, this optimizing model would determine the best GME configuration for each year based upon the value score for all years. That is, it would determine the best solution for the whole time period.

While the above illustrative methodology has been presented as if it were a single quantification, its actual use would be based upon repeated analysis of each component to reflect the uncertainty of the quantifications and to estimate the sensitivity of the complete methodology to various assumptions. In each step of the analysis, a wide range of solutions would be obtained and the more important, reasonable and acceptable alternative solutions would be used as inputs to the next step.

It should be re-emphasized that this is an illustrative methodology, based only upon minimal consideration of the problems that undoubtedly be encountered in its actual operation. GMENAC will obviously wish to consider the alternatives more fully. If resources and time permit, it might be advisable to develop a second quantification utilizing a quite different analytic approach. Although not tested enough for use as a primary approach, Systems Dynamics (described earlier) suggests itself for this role. It is an equilibrating, single-model approach that would provide a check upon a segmented

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40/ While these two optimizing models could be combined into a single model with a mixed utility function, such models are more complex and there is the more serious concern that the clarity of the analysis would be greatly reduced. With two small models it is much less difficult to understand just what is occurring and to check for reasonableness.

model and would adapt to high uncertainty well enough to be achievable.

Conclusion

Although this paper has dwelt upon the specifics of manpower requirements estimation and projection, and has emphasized the many difficulties and complexities involved, the positive aspects of the GMENAC task deserve brief mention. The task is as difficult as it is because there has been no coordinated, focused data collection and analysis program. In recent years, knowledge of the health care system has increased substantially and it is now being seen and understood in greater detail than ever before. A very important part of the GMENAC effort will be in the extended sense of purpose and direction that it can provide to the continuing efforts to better understand the forces at work. If the Nation is to be better able to develop reasonable health policies in the future, it will be because long-term direction and developmental priorities are being considered and developed now. Data and analytic capability are developed only over the course of many years and it is too late to begin the effort when policy issues need immediate resolution.

The other positive aspect of the GMENAC task is the opportunity it presents to target more adequately the emphasis of policy analysis. In the past, policy analysis has not recognized the importance of uncertainty and the need to address strategies for dealing with lack of firm knowledge. Similarly, there has been a tendency in the past to talk in terms of simple shortages and surpluses, obscuring the choices between alternative policies, each with some desirable features. It is hoped that the GMENAC will help to change the situation.

* U. S. GOVERNMENT PRINTING OFFICE : 1977 241-186/1076

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